

UNITED STATES ARMY SCHOOL OF AVIATION MEDICINE

Night Vision Orientation

Terminal Learning Objective

- ▣ Action: Manage the effects of visual limitations during night flight
- ▣ Condition: While performing as an aircrew member
- ▣ Standard: In accordance with (IAW) TC 3-04.93, FM 3-04.203, FM 8-50, AR 40-501, and AR 40-8

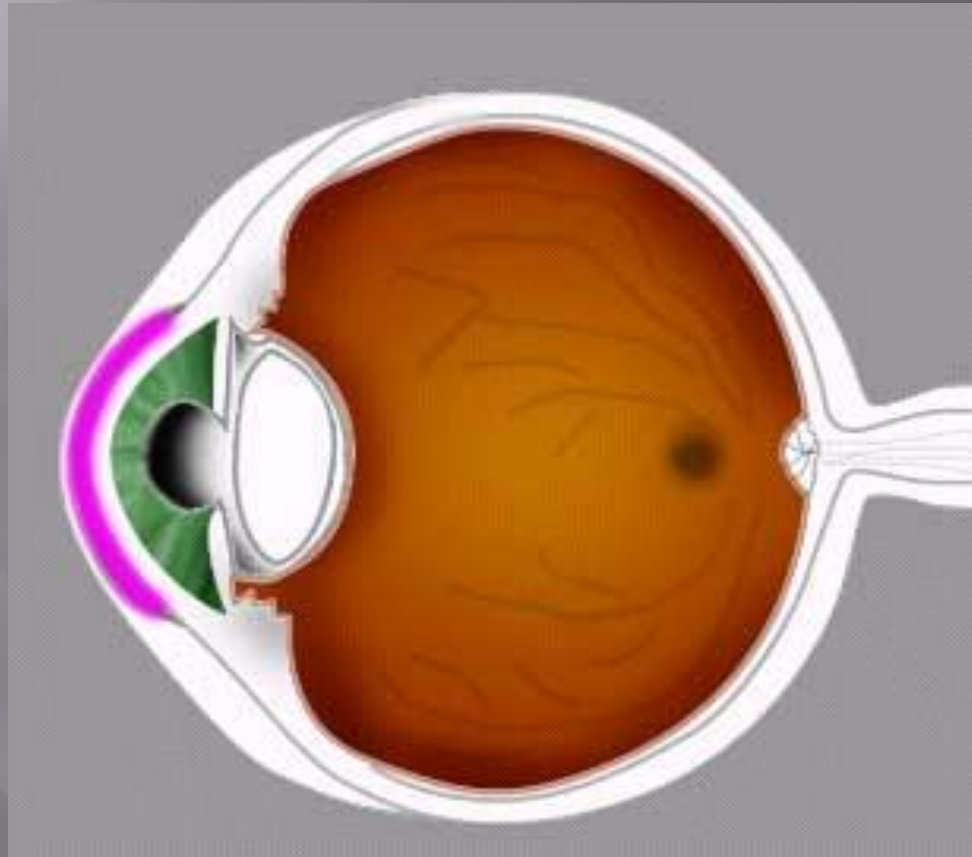
Administrative Information

- ▣ Risk Assessment: Low
- ▣ Environmental Considerations: None
- ▣ Safety Considerations: None
- ▣ Evaluation: 25 question examination; 70% required to pass

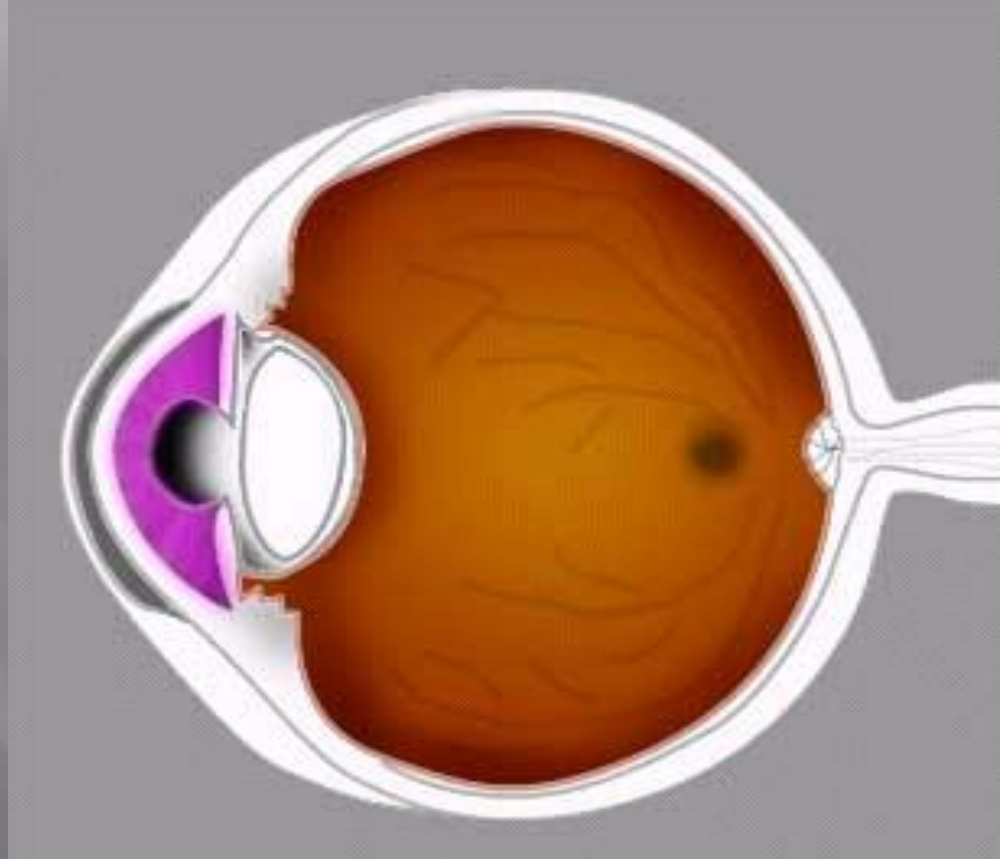
ELO A

- ▣ Action: Identify the components of the eye and its functions
- ▣ Condition: Given a list
- ▣ Standard: IAW TC 3-04.93 and FM 3-04.203

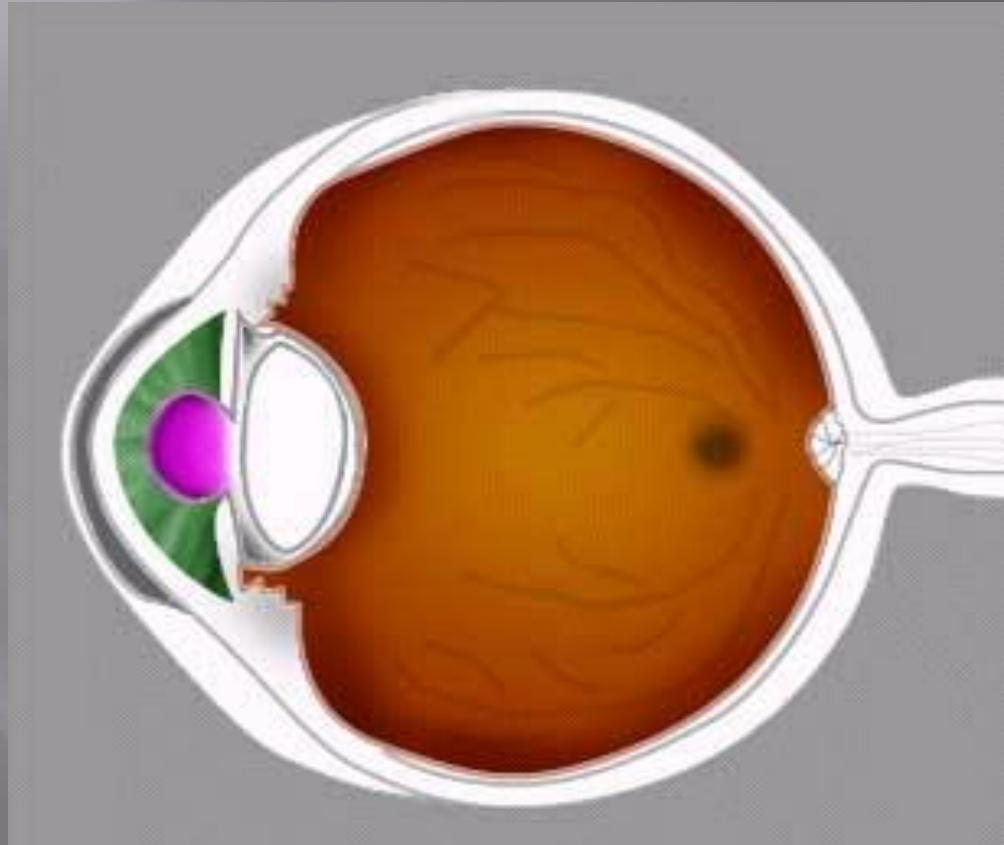
Anatomy of the eye- Cornea



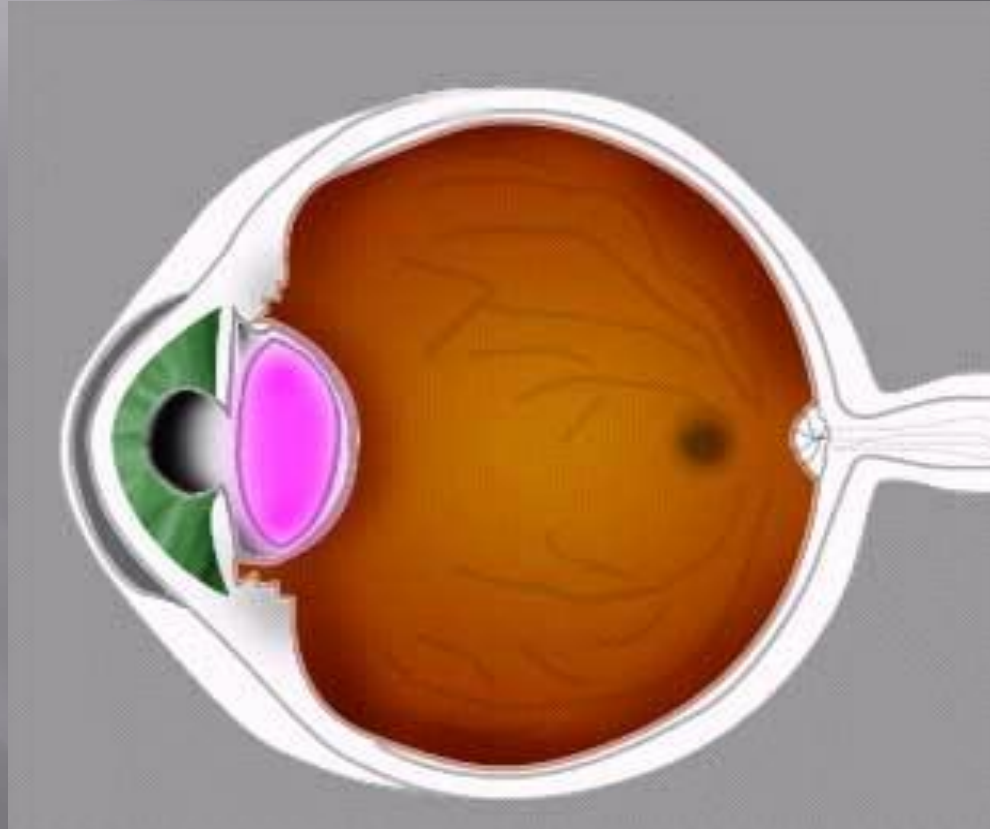
Anatomy of the eye- Iris



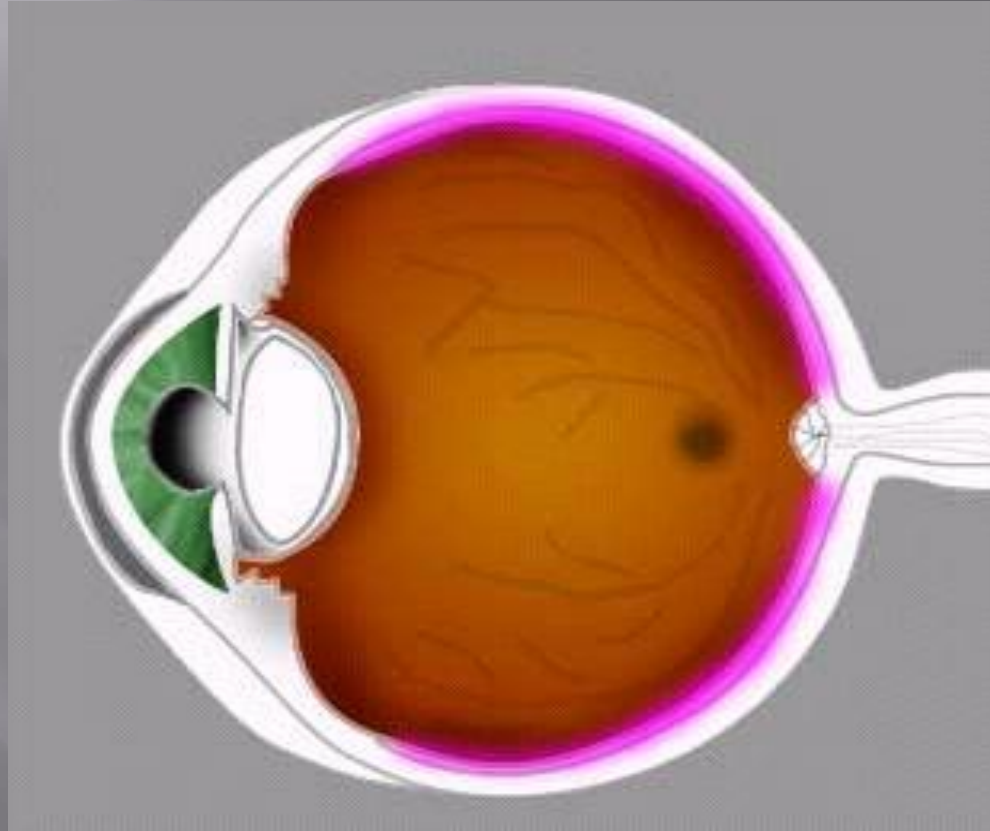
Anatomy of the eye- Pupil



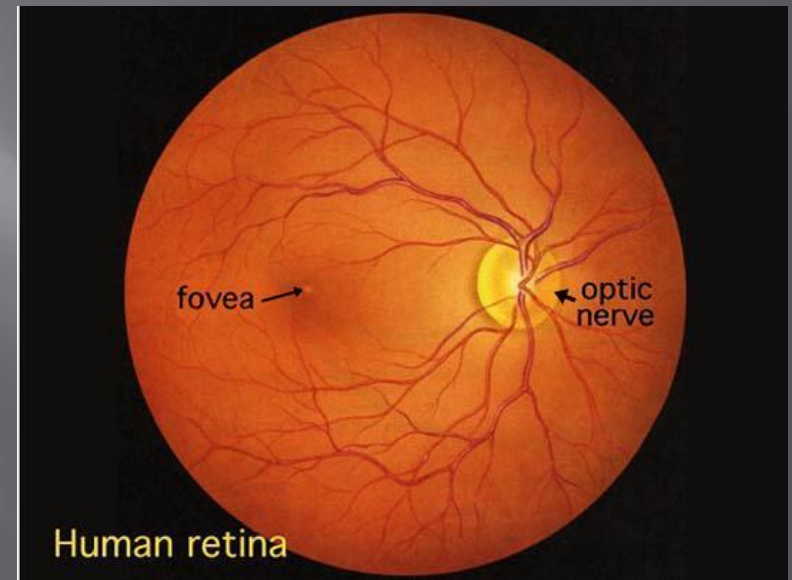
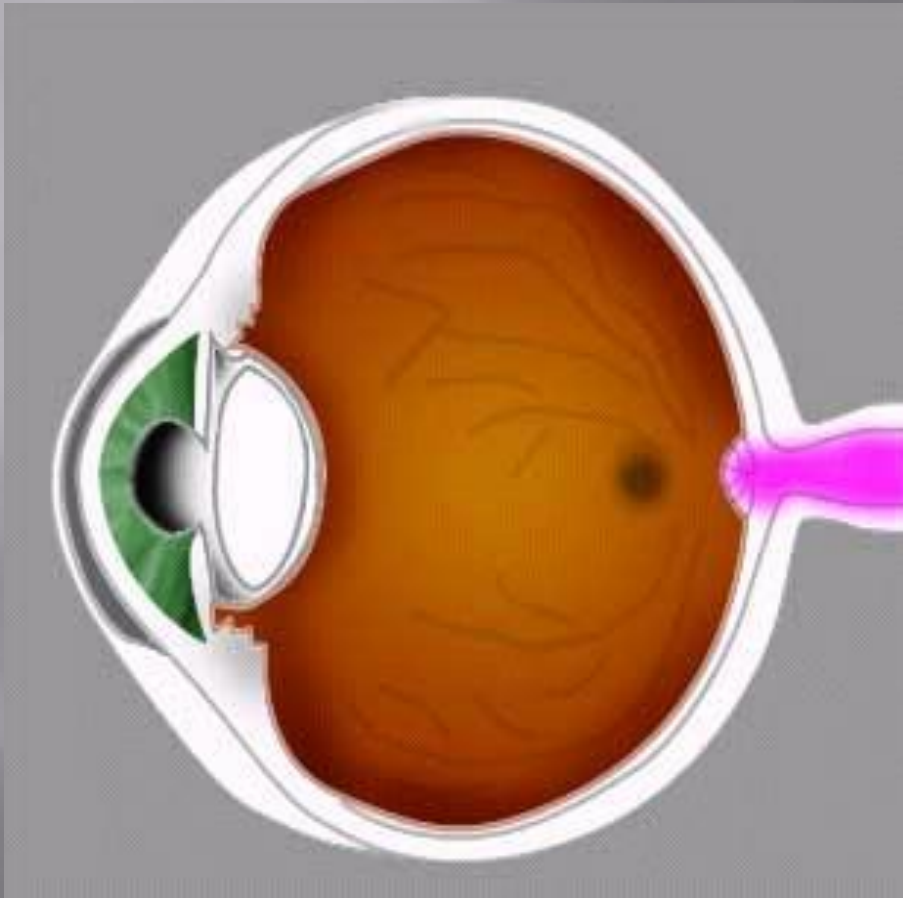
Anatomy of the eye- Lens



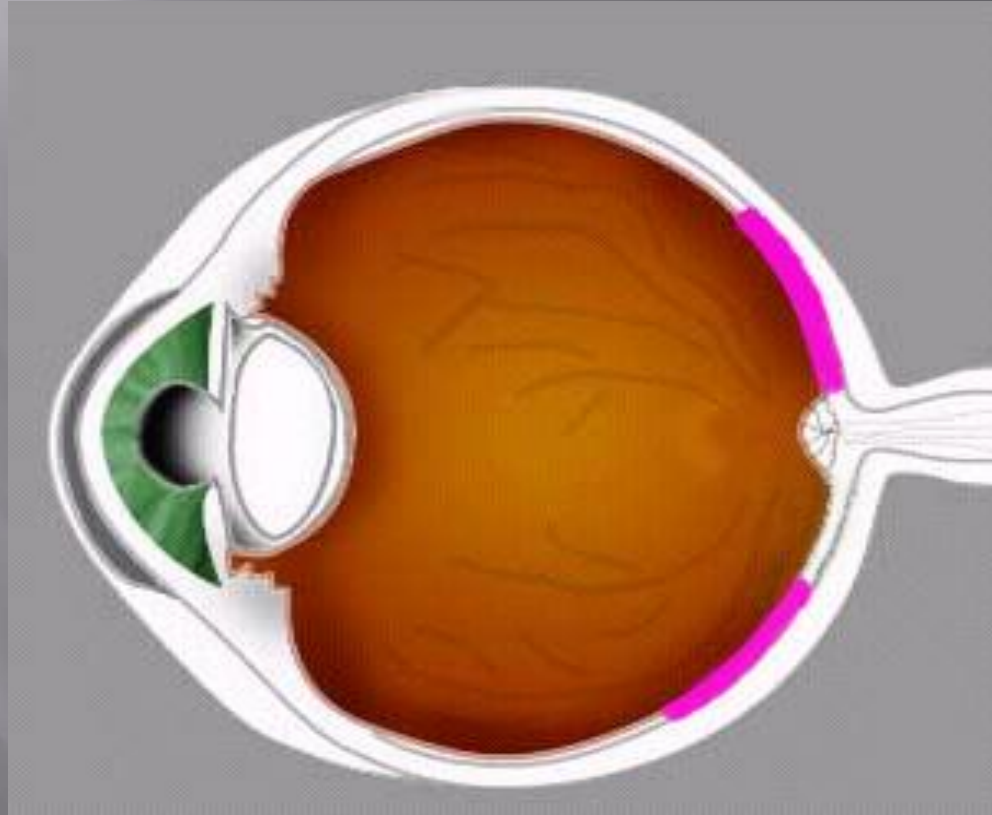
Anatomy of the eye- Retina



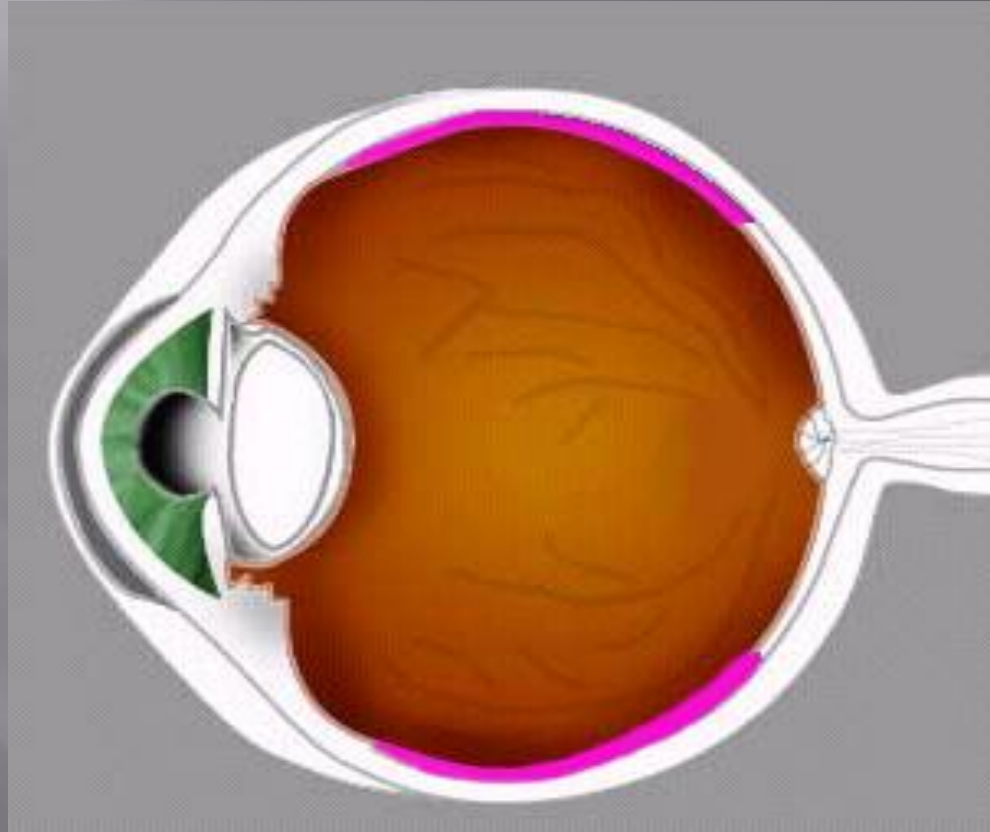
Anatomy of the eye- Optic Disk



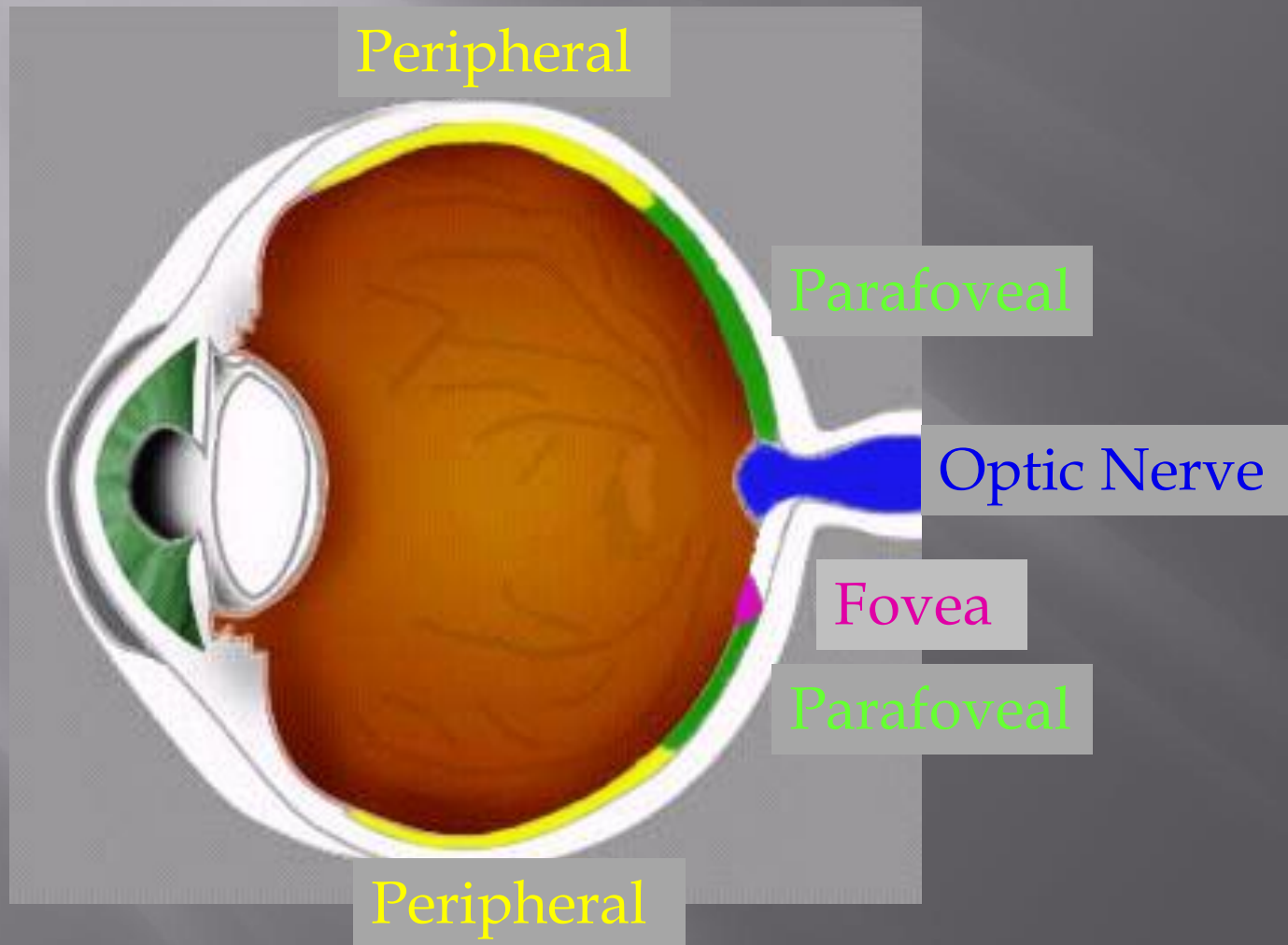
Anatomy of the eye- Parafoveal Region



Anatomy of the eye- Peripheral Regions



Anatomy of the eye- Overview



Check on Learning

- ▣ Which area of the retina contains no photoreceptor cells and is known as the day blind spot?

Optic Disk

- ▣ Which structure of the eye controls the amount of light entering the eye?

Iris

- ▣ What is the clear, outer, protective layer of the eye called?

Cornea

ELO B

- ▣ Action: Identify the functions of rod cells during night flight
- ▣ Condition: Given a list
- ▣ Standard: IAW TC 3-04.93 and FM 3-04.203

Photoreceptor Cells

CONE CELLS

- ▣ Used in periods of bright light
- ▣ Identifies colors
- ▣ Sharp visual acuity and color sense
- ▣ 7 million in fovea and parafoveal regions
- ▣ 1:1 ratio of cone cells to neuron cells
- ▣ Produces **Iodopsin**

ROD CELLS

- ▣ Used in periods of low ambient light and darkness
- ▣ Identifies outline of shapes and silhouettes
- ▣ Poor color sense and visual acuity
- ▣ 120 million rod cells
- ▣ 10:1 to 10,000:1 ratio of rod cells to neuron cells
- ▣ Produces **Rhodopsin** (Visual Purple)

Retinal Blind Spots

DAY BLIND SPOT:

- ▣ Related to position of optic disc on the retina
- ▣ Located 15 degrees from fovea
- ▣ No photoreceptor cells
- ▣ Encompasses 5.5 to 7.5 degrees of visual field

NIGHT BLIND SPOT:

- ▣ Located in central viewing axis (fovea)
- ▣ Absence of rod cells in fovea
- ▣ Inability of cone cell function
- ▣ Encompasses viewing area of 5 to 10 degrees center of visual field

Check on Learning

- ▣ Which cells are utilized mostly during time periods or conditions of low ambient lighting and darkness?

Rods

- ▣ Which cells are utilized to identify color?

Cones

- ▣ What is the ratio of rod cells to neuron cells?

(10:1 up to 10,000:1)

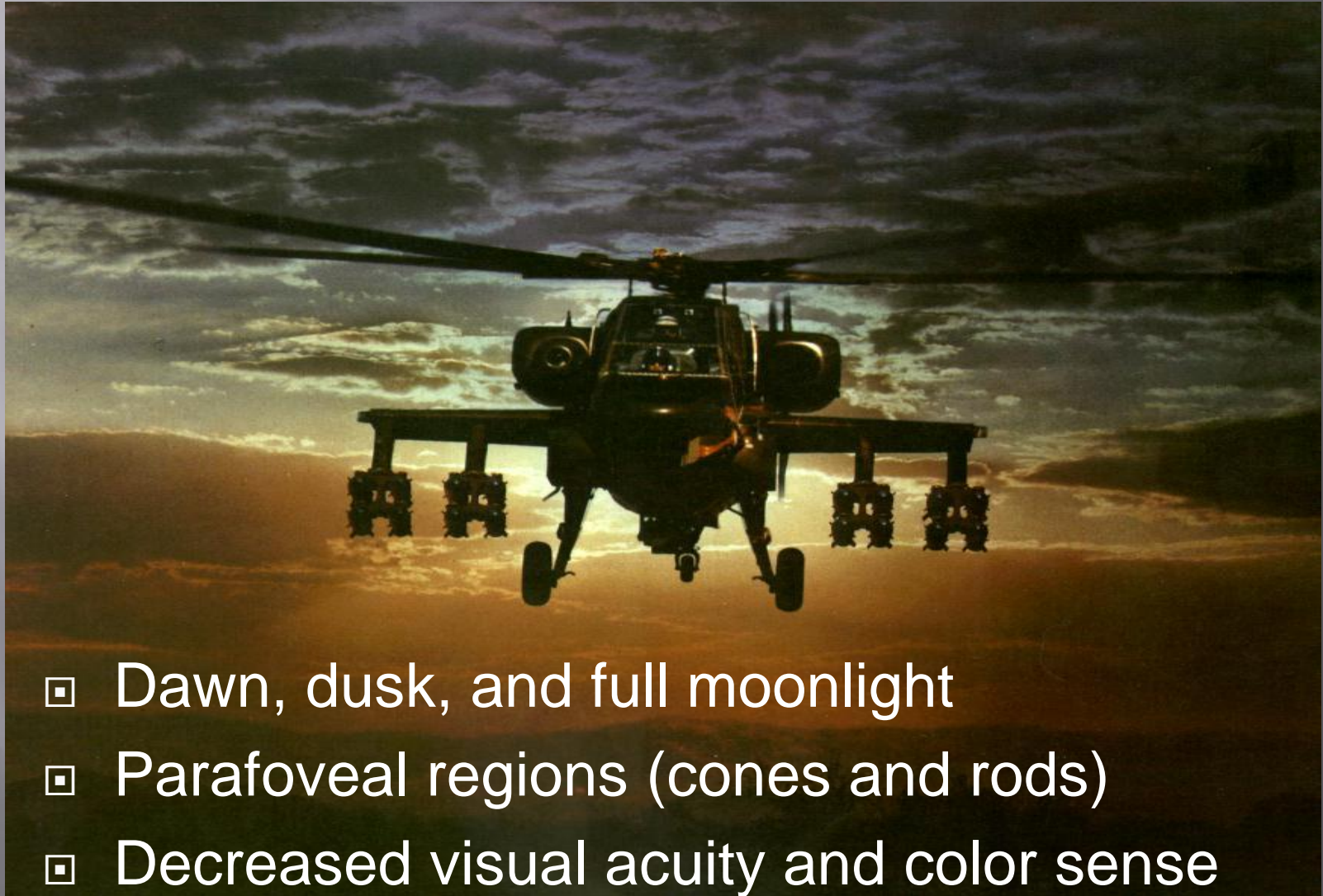
- ▣ The day blind spot covers an area of _____ degrees within an individual's visual field and is located about _____ degrees off center from the fovea.

5.5 to 7.5 and 15

ELO C

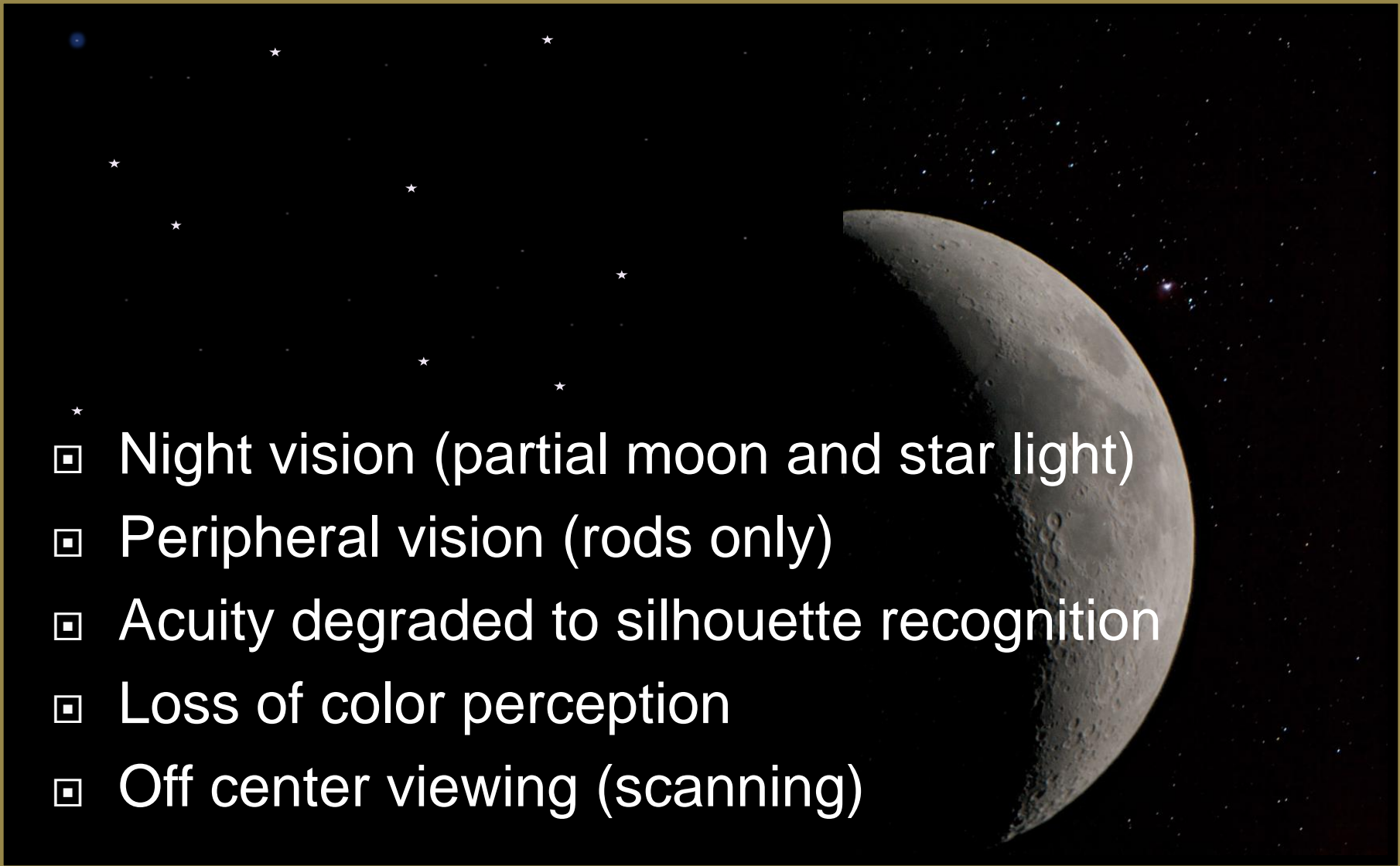
- ▣ Action: Identify the different types of vision when viewed during decreased ambient light conditions
- ▣ Condition: Given a list
- ▣ Standard: IAW TC 3-04.93 and FM 3-04.203

Mesopic Vision



- ▣ Dawn, dusk, and full moonlight
- ▣ Parafoveal regions (cones and rods)
- ▣ Decreased visual acuity and color sense

Scotopic Vision

- 
- ▣ Night vision (partial moon and star light)
 - ▣ Peripheral vision (rods only)
 - ▣ Acuity degraded to silhouette recognition
 - ▣ Loss of color perception
 - ▣ Off center viewing (scanning)

Check on Learning

- ▣ What type of vision are we using during dawn and dusk?

Mesopic

- ▣ The _____ region is a mixture of cones and rods which is the primary source of mesopic vision?

Parafoveal

- ▣ What type of vision are we using at night during partial moon and starlight lighting conditions?

Scotopic

- ▣ What is the best unaided visual acuity during scotopic periods?

20/200

ELO D

- ▣ Action: Identify the factors that affect dark adaptation
- ▣ Condition: Given a list
- ▣ Standard: IAW TC 3-04.93 and FM 3-04.203

Dark Adaptation

- ▣ Average time required is 30-45 minutes
- ▣ Exposure to intense sunlight, glare off sand, snow, or water will increase the time required to dark adapt, for up to 5 hours
- ▣ After full dark adaptation, 3-5 minutes required to “re-dark adapt” if exposed to a brief, bright light
- ▣ Vitamin A required for production of Rhodopsin



Dark Adaptation

- ▣ Exposure to bright light or glare for 2-5 hours may affect night vision acuity and rod cell sensitivity for several days
- ▣ Dark adaptation time required after exposure to brief flashes (anti-collision light strobes) is less than after exposure to bright lights of longer duration (flares, search/landing light)
- ▣ Use of red lens goggles will assist dark adaptation by reducing time required

Check on Learning

- ▣ Cone cells contain a chemical called _____.

Iodopsin

- ▣ What photochemical is used by the rods and is sometimes referred to as “Visual Purple”?

Rhodopsin

- ▣ What is the average time it takes to dark adapt?

30-45 minutes

- ▣ Vitamin _____ is required for production of Rhodopsin.

Vitamin A

ELO E

- ▣ Action: Identify limitations to night vision
- ▣ Condition: Given a list
- ▣ Standard: IAW TC 3-04.93 and FM 3-04.203

Limitations of Night Vision

- ▣ Depth perception
(safe landings)
- ▣ Visual acuity
(obstacle
identification)
- ▣ Night blind spot
- ▣ Dark adaptation
(time factor)
- ▣ Color perception
- ▣ Night myopia
- ▣ Visual cues

Depth Perception

- ▣ False interpretation or judgment of actual altitude
- ▣ Proper crew coordination
- ▣ Use searchlight or landing light if mission permits



UNCLASSIFIED

What do you see?



UNCLASSIFIED

Now what can you see?



UNCLASSIFIED

What do you see?



UNCLASSIFIED

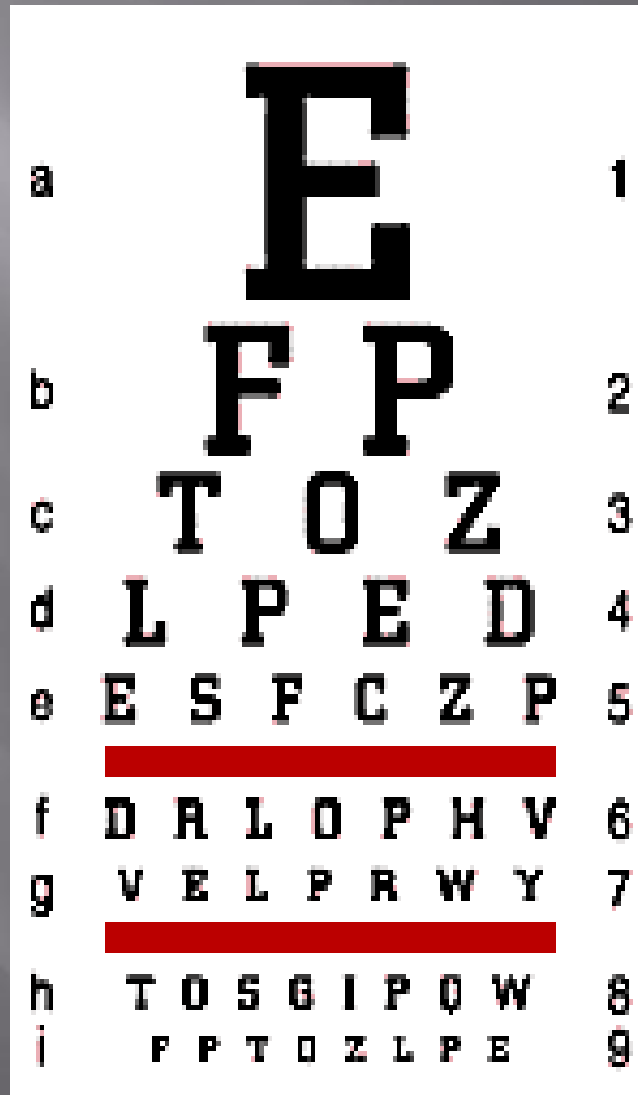
Now what can you see?



Visual Acuity

20/200

20/200

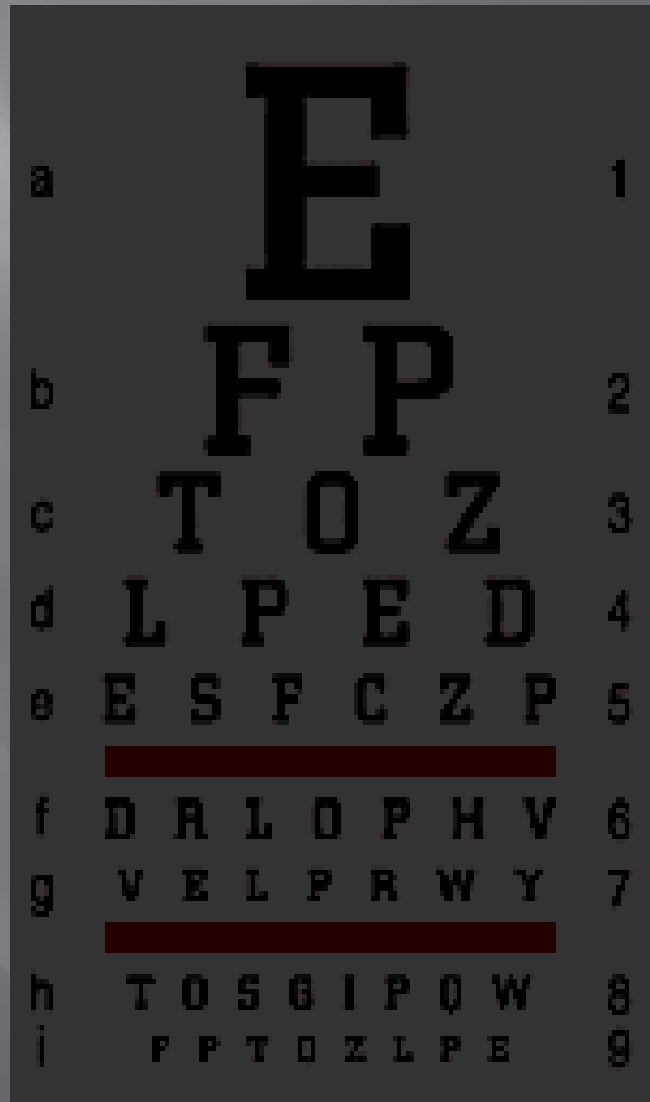


20/20

20/20

Visual Acuity

20/200

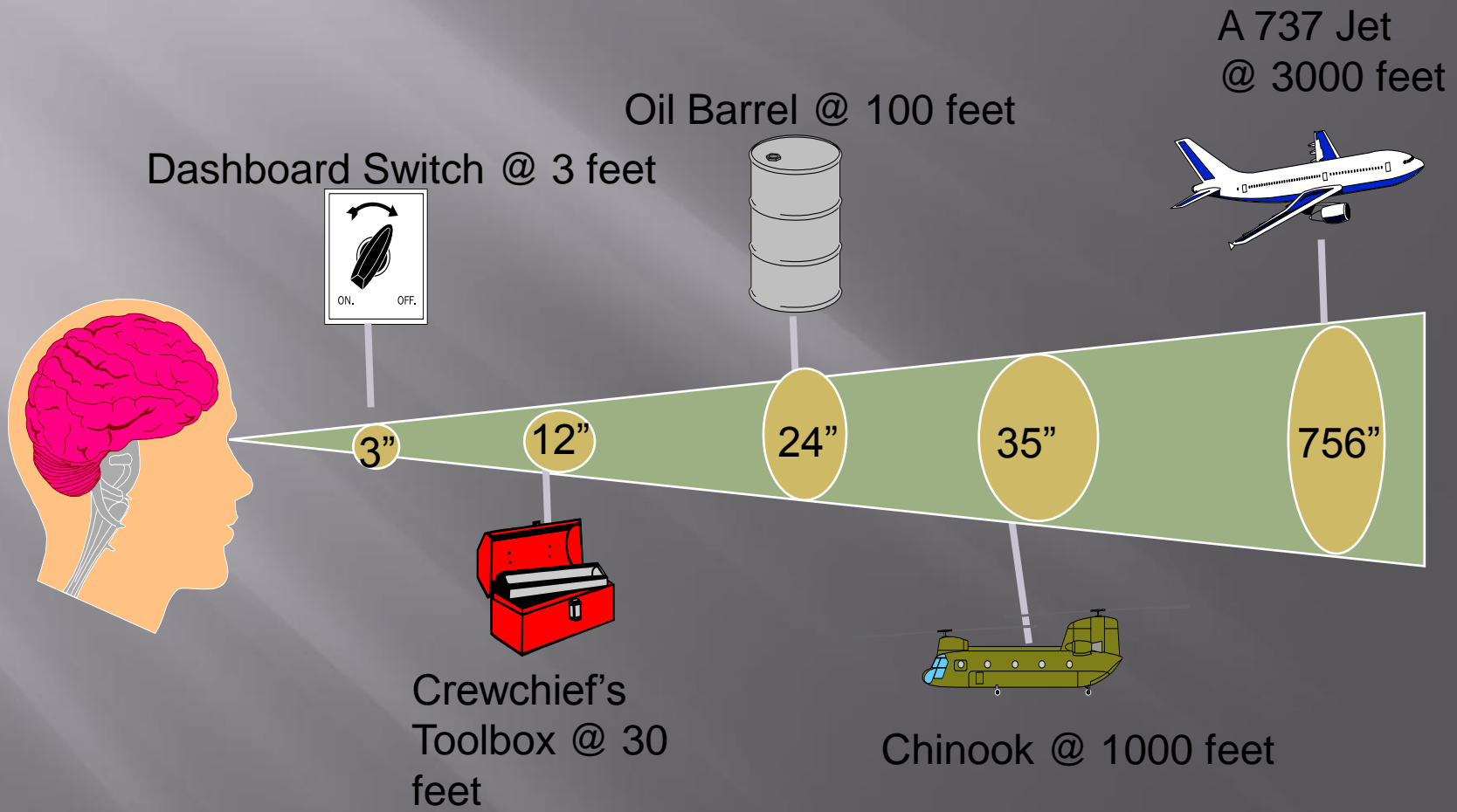


20/200

20/20

20/20

Night Blind Spot



Night Myopia

- ▣ Blue wavelength lighting causes night myopia
- ▣ Image sharpness decreases as pupil diameter increases
- ▣ Mild refractive error factors combined, creates unacceptably blurred vision
- ▣ Focusing mechanism of the eye may move toward a resting position (increases myopic state)

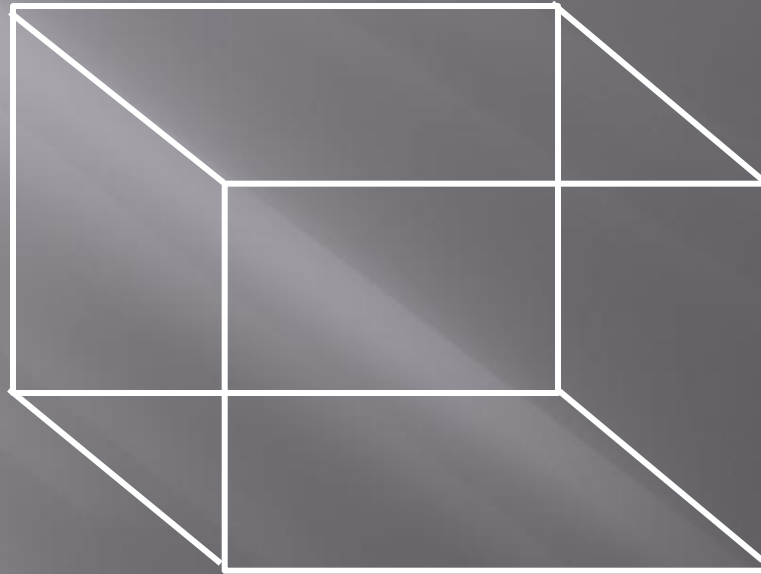
Visual Illusions

- ▣ Fascination (fixation) in flight
- ▣ False horizon
- ▣ Flicker vertigo
- ▣ Crater illusion
- ▣ Relative motion
- ▣ Altered planes of reference
- ▣ Size-distance illusion
- ▣ Height-depth illusion
- ▣ Confusion with ground lights
- ▣ Structural illusion
- ▣ Autokinetic illusion
- ▣ Reversible perspective

Visual Cues

- ▣ Binocular Cues: subconscious & of less value in flight environment due to increased distances
- ▣ Monocular Cues: → **G R A M**
 - **G**eometric perspective: → **L A V**
 - **R**etinal image size: → **K I T O**
 - **A**erial perspective: → **F L P**
 - **M**otion parallax: **most important** cue to depth perception

Geometric Perspective



- ▣ Objects have different shapes when viewed at varying distances and altitudes

Geometric Perspective



Linear
perspective



Apparent
foreshortening

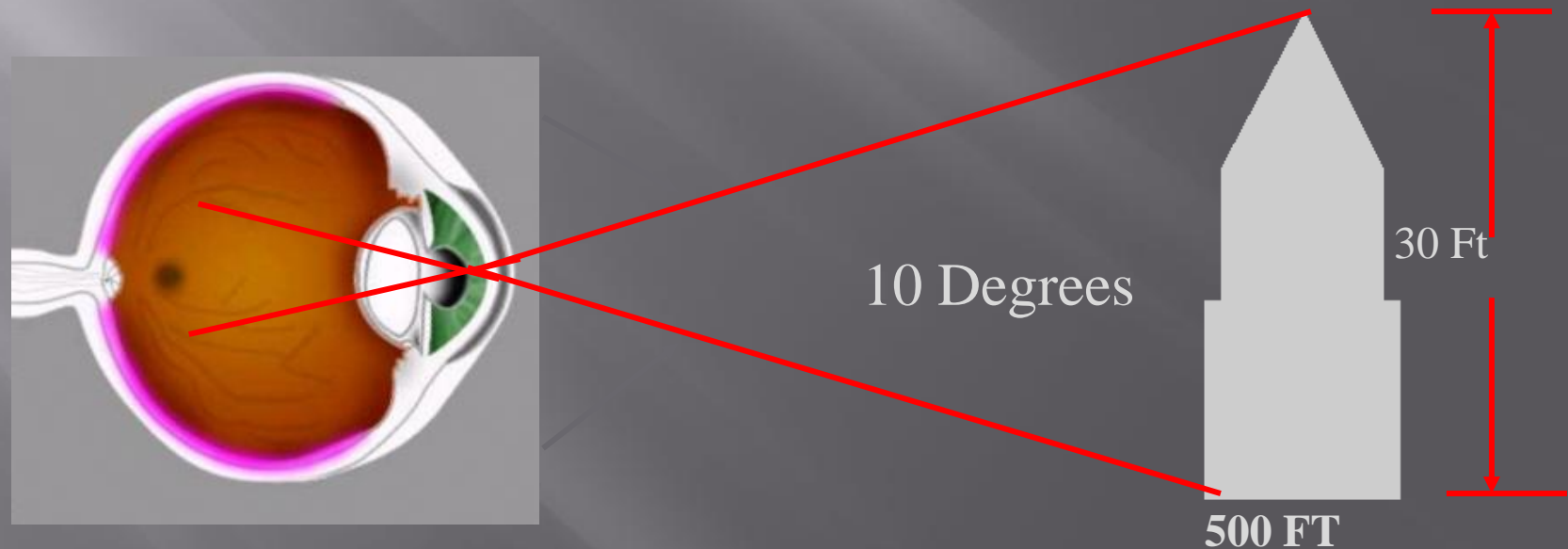
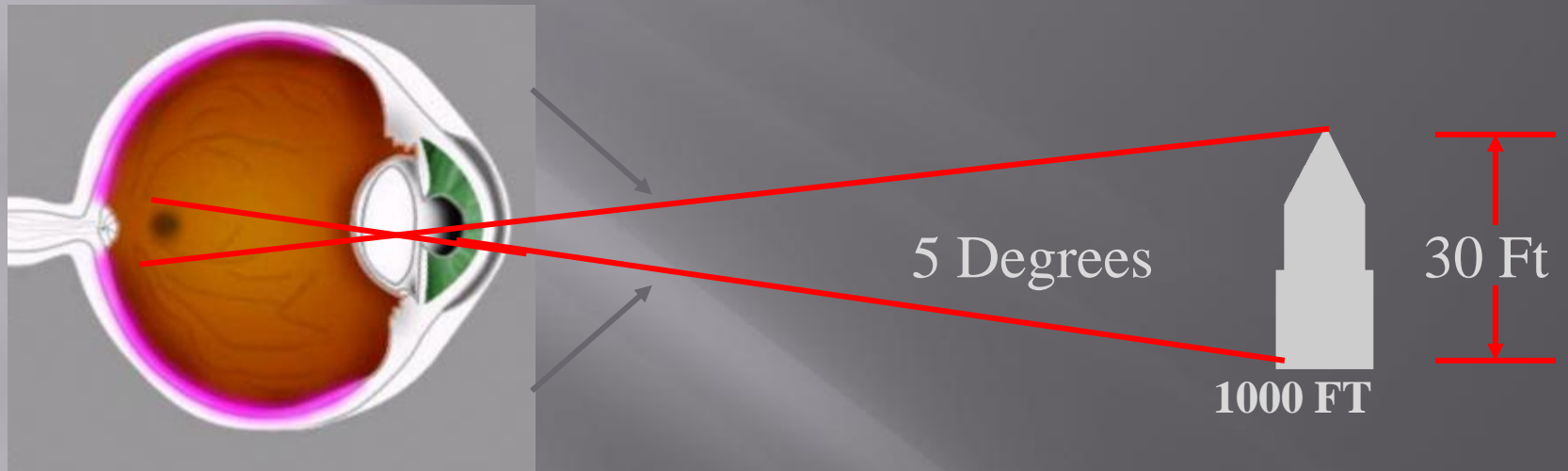


Vertical position
in the field

Retinal Image Size

- ▣ **K**nown size of objects
- ▣ **I**ncreasing or decreasing size of objects
- ▣ **T**errestrial association
- ▣ **O**verlapping contours

Known Size of Objects



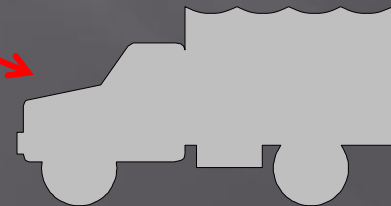
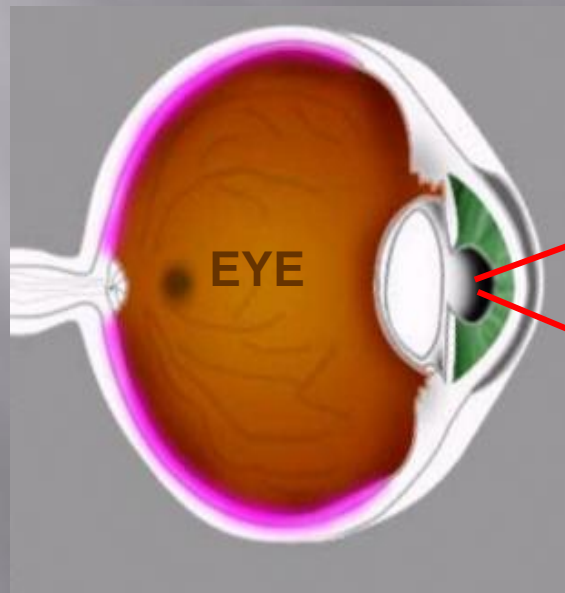
Increase (or Decrease) in Size

INCREASE IN SIZE



DECREASE IN SIZE

Terrestrial Association

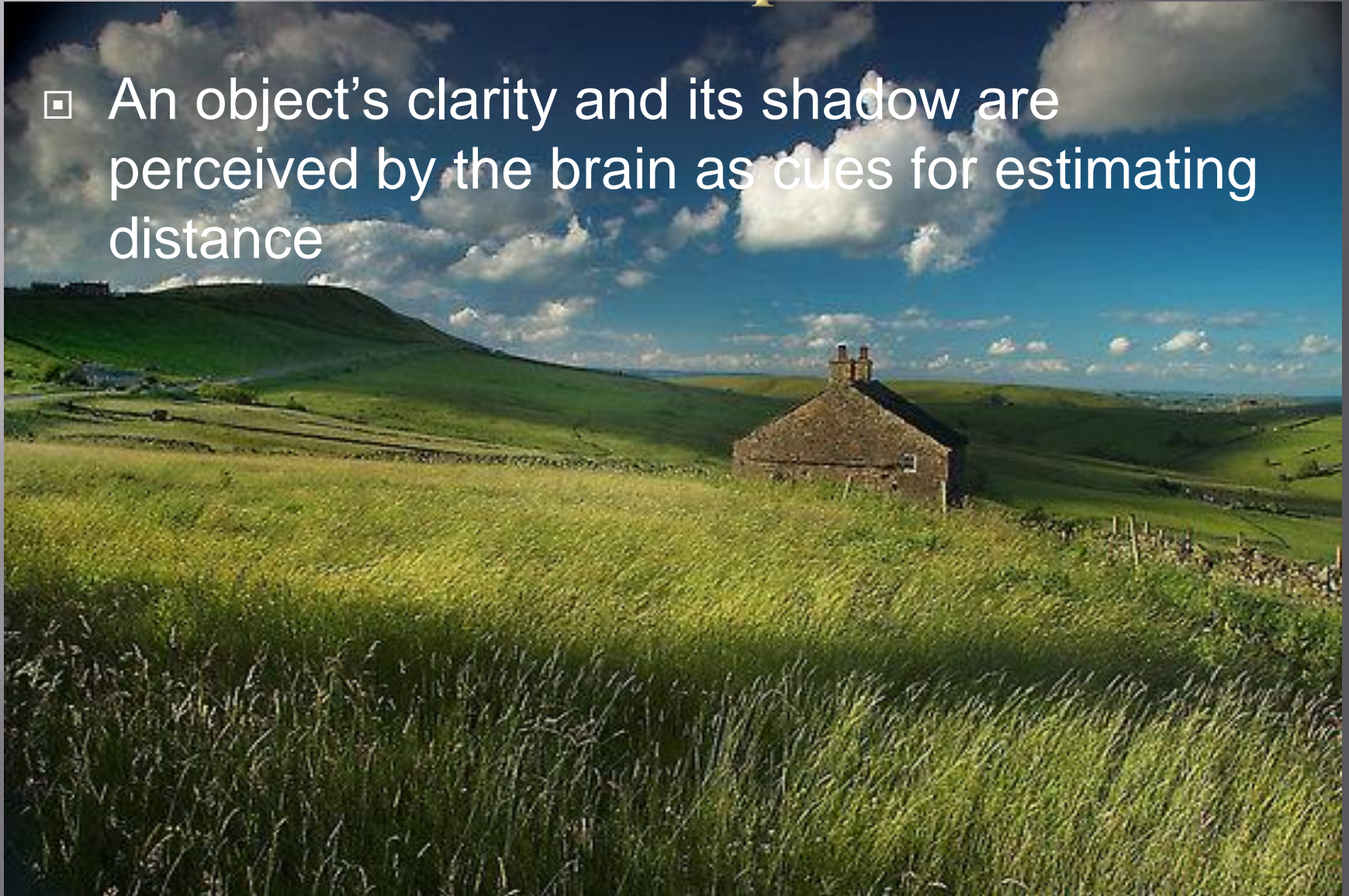


Overlapping Contours

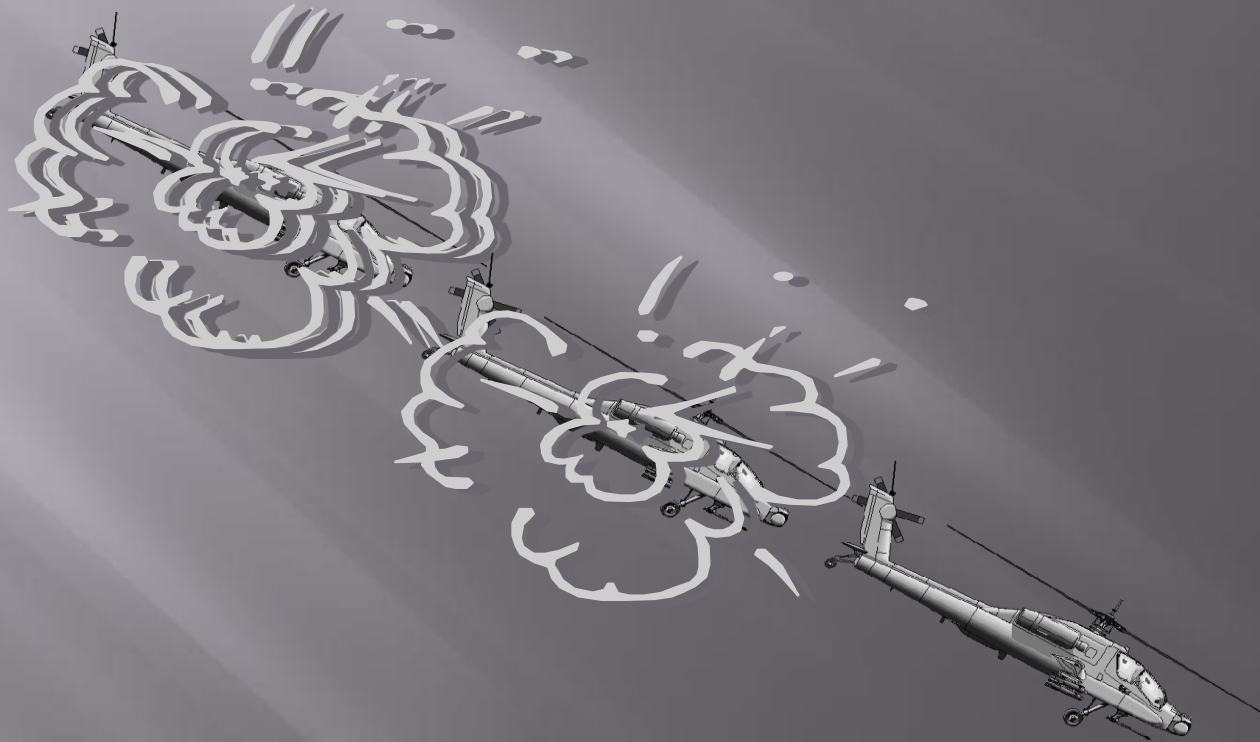


Aerial Perspective

- ▣ An object's clarity and its shadow are perceived by the brain as cues for estimating distance



Fading of Colors and Shades



Loss of Texture and Detail



Position of Light Source



Motion Parallax

- ▣ Most important cue to depth perception
- ▣ Stationary objects
- ▣ Observer in motion
- ▣ Rate of the apparent motion depends on the distance of the object relative to the observer



Check on Learning

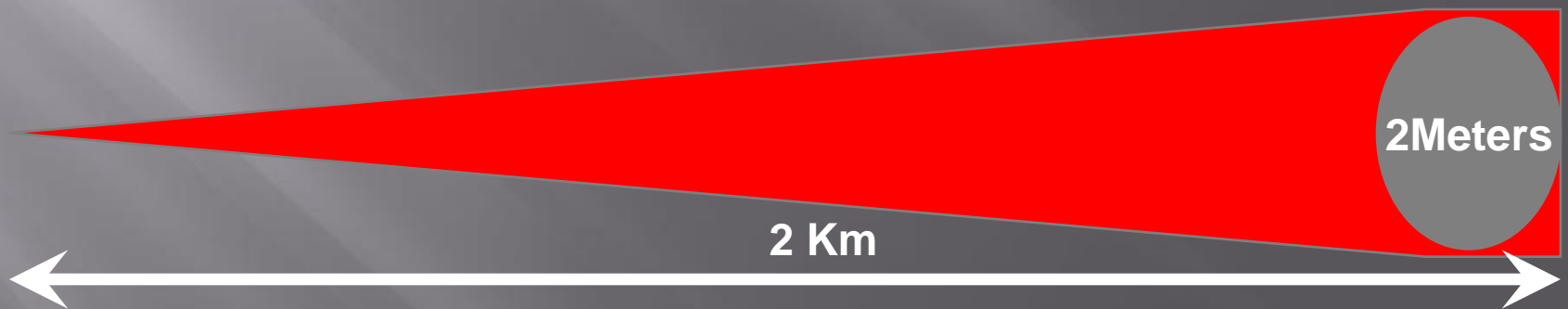
- ▣ What are some of the limitations of night vision?
Depth Perception, Visual Acuity, Night Blind Spot, Dark Adaptation, Color Perception, Night Myopia, and Visual Cues
- ▣ What is the most important monocular cue to depth perception?
Motion parallax
- ▣ (T/F) The night blind spot increases in size with distance?
True
- ▣ What illusions are part of the Geometric perspective making the acronym (LAV)?
Linear Perspective, Apparent Foreshortening, and Vertical Position in the Field

ELO F

- ▣ Action: Identify the methods to protect visual acuity from night flight hazards and limitations
- ▣ Condition: Given a list
- ▣ Standard: IAW AR 40-8, TC 3-04.93, FM 3-04.203, and FM 8-50

LASER

- ▣ **L**ight **A**mplification by a **S**timulated **E**mission of **R**adiation
 - Intense, narrow beam of light, less than 1 inch in diameter
 - Widens with distance: 2km-diameter is 2 meter



LASER Injuries

- ▣ Lens: focuses and concentrates light rays entering the eye
- ▣ Concentration of energy through the lens is intensified 100,000 times greater than the normal light entering the eye
- ▣ Amount of damage depends on laser type, exposure time, and distance from the laser
- ▣ Types of injuries:
 - Tiny lesions on the back of the eye
 - Flash blindness
 - Impaired night vision
 - Severe burns effecting vast body portions

LASER Protective Measures

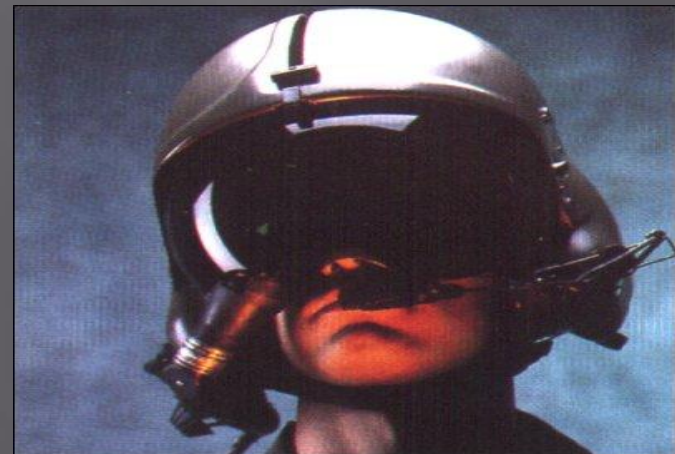
PASSIVE

- ▣ Take cover
- ▣ NVDs
- ▣ Squinting
- ▣ Protective goggles



ACTIVE

- ▣ Counter measures taught or directed
- ▣ Evasive action
- ▣ Scanning with one eye or monocular optics



Nerve Agents

- ▣ Threat present both day and night at low level flight
- ▣ Consult flight surgeon immediately
- ▣ Severity of miosis depends on agent concentration and cumulative effects of repeated exposure
 - Direct or minute exposure will cause miosis (pupil constriction)
 - Severe miosis may persist for 48 hrs
 - Complete recovery may take up to 20 days



Methods to Protect Night Vision

Avoid bright lights during unaided flight

- ▣ Sources
 - Aerial and ground flares
 - Spotlights, and headlights
 - Search and landing lights
 - Beacon lights
 - Muzzle flash and tracer fire
- ▣ Overall protective measures
 - Lower clear visor
 - Adjust dashboard, rear crew compartment, and exterior lights
 - Close or cover one eye
- ▣ Other useful protective measures
 - Short ordnance bursts
 - Turn head away
 - Transfer the controls
 - Change heading
 - LASER threats
 - ▣ Use B-LPs
 - ▣ Distance from LASER
 - Minimize Stressors
 - Supplemental oxygen
 - Proper nutrition
 - Avoid dehydration

Check on Learning

- ▣ What is the best protection against LASERs?

Distance is the best protection, but if that is not possible the use of laser specific protective goggles and visors B-LPS (Ballistic Laser Protective Spectacles) will provide protection

- ▣ What is the eye condition caused by exposure to minute doses of nerve agents?

Miosis

- ▣ (T/F) To preserve night adaptation it is best to avoid exposure to bright light during night unaided flight.

True

ELOG

- ▣ Action: Identify the effects of self-imposed stresses
- ▣ Condition: Given a list
- ▣ Standard: IAW AR 40-8, TC 3-04.93, and FM 3-04.203

Self-Imposed Stresses

Click speakers to hear more!

▣ **D**rugs



▣ **E**xhaustion



▣ **A**lcohol



▣ **T**obacco



▣ **H**ypoglycemia



Check on Learning

- ▣ Which army regulation should you refer to for restrictions for drug use while on flying status?

AR 40-8

- ▣ AR 40-8 states that crew members will not perform flight duties within _____ hours of consuming an alcoholic beverage and then until there are _____ residual effects remaining.

12 Hrs and No

- ▣ Poor dieting can lead to Vitamin A deficiency, which hinders production of _____ thus hindering night vision.

Rhodopsin

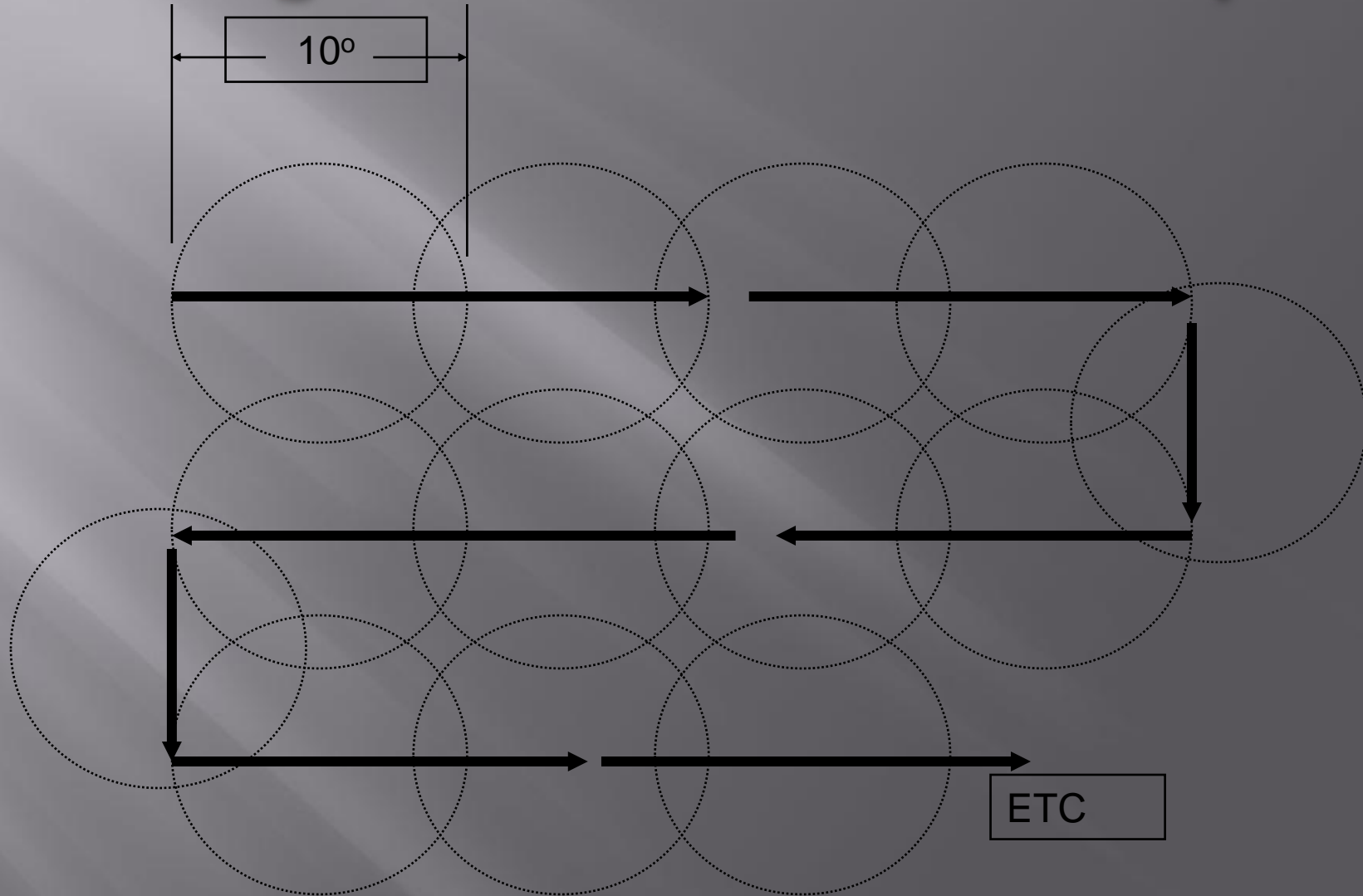
ELO H

- ▣ Action: Identify the proper night viewing (scanning) techniques
- ▣ Condition: Given a list
- ▣ Standard: IAW TC 3-04.93 and FM 3-04.203

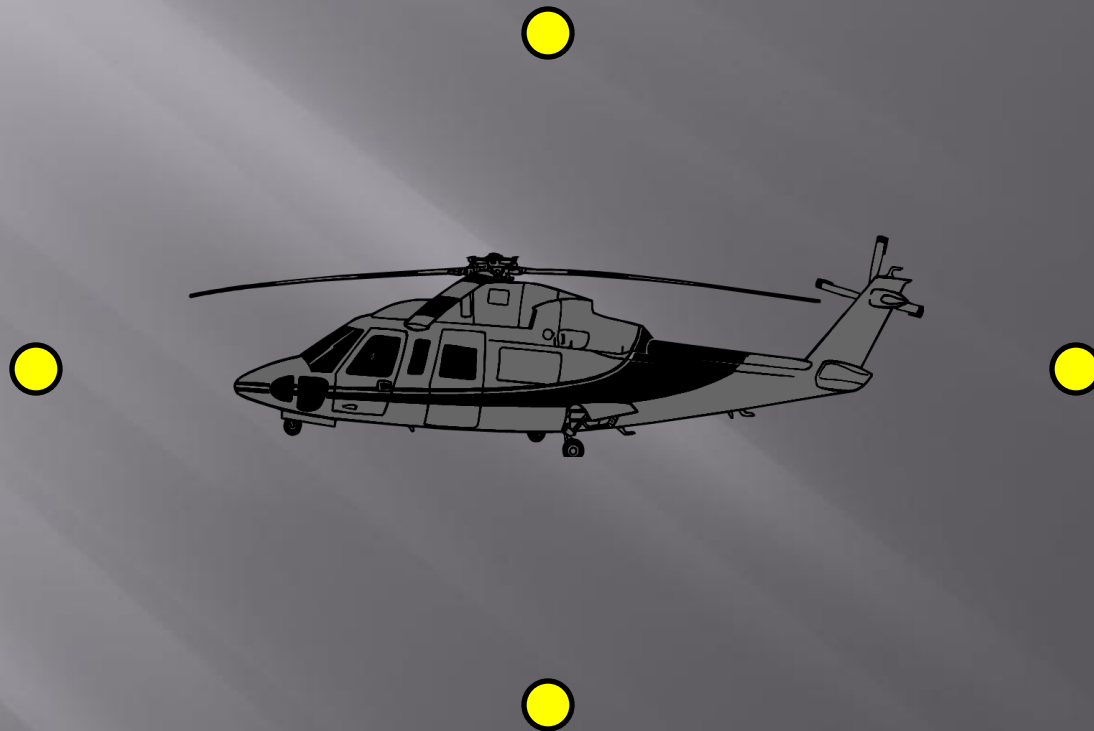
Scanning Techniques

- ▣ Stop-turn-stop-turn technique
- ▣ Ten degree circular overlap
- ▣ Off-center viewing: 10 degrees

Ten Degree Circular Overlap



Off Center Viewing



Check on Learning

- ▣ What are three night vision scanning techniques?

Stop-turn-stop-turn, Ten degree circular overlap, and off-center viewing: ten degrees

- ▣ The duration of each stop in the stop-turn – stop-turn technique should last longer than _____ to _____ seconds to prevent the rhodopsin from bleaching out the image.

2 to 3

ELO I

- ▣ Action: Identify the physiological effects of night vision devices (NVDs)
- ▣ Condition: Given a list
- ▣ Standard: IAW TC 3-04.93 and FM 3-04.203

Physiological Effects of NVD's

- ▣ Depth perception:
 - Distance estimation is reduced
 - Chromatic adaptation or discoloration of objects
 - Regain dark adaptation three to five minutes
- ▣ Spatial disorientation:
 - A/C bank greater than 30 degrees
 - Rapid scan technique
 - Unfamiliar perception due to lack of NVG experience



Check On Learning

- ▣ What is the average time it takes to dark adapt?
30-45 minutes
- ▣ What type of vision are we using during dawn and dusk?
Mesopic
- ▣ What is the eye condition caused by exposure to minute doses of nerve agents?
Miosis
- ▣ What photochemical is used by the rods and is sometimes referred to as “Visual Purple”?
Rhodopsin

Exam Time

- ▣ [US Army Learning Center Login](#)
- ▣ Log in using AKO username and password or CAC
- ▣ Search “Courses” tab for “USASAM” or “Night Vision”
- ▣ Select Night Vision Orientation and click “enroll” using Access Code: “USASAM”
- ▣ Take exam using password: “USASAM”
- ▣ You must score 70% or better/ 25 questions
- ▣ You will have one hour to complete the exam